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language is made up almost entirely upon Latin roots although it admits some others in its vocabulary. For further explanation we quote from the *Interlingua* circular the following paragraphs.

"Latino es in parte internationale, et in parte mortuo. Scriptore, que adopta toto vocabulario latino, cum grammatica simplice, es intellecto ab lectore que consulta vocabulario latino, sed non intelligibile ad primo visu. Pro scribe in modo subito intelligibile, es necesse vocabulario de latino internationale. Academia judica internationale omni vocabulo latino existente in vocabulario etymologico de anglo. Latino et anglo es duo extremitate, in tempore et spatio, de lingua internationale.

"Vocabulario latino-anglo pote es substituto, sine errore sensibile, per latino-français aut latino-italiano etc. Vocabulo latino, vivo in nostro lingua, es bono. Si vocabulo latino es mortuo, quære æquivalente in dictionario de synonymos. In ipso vocabulario latino-nationale, ad voce nationale, sæpe responde plure synonymo latino et viceversa.

"Academia adopta omni voce internationale, et non scripto in vocabulario latino ad usu de schola, per exemplo: *reale* (ex L. *reale*) *acephalo* (ex Græco), *telegrapho* (ex. G. *tele graph -o*), *artista* ex L. *arte* et G. *-ista*),*algebra* (L. math. ex Arabo), *tabaco* (L. botanico ex Americano), etc."

THE MULTIPLICATION OF PEARS AND PENCE.

We are in receipt of an open letter by Frederick Hovenden which attacks most vigorously the present system of teaching algebra. It contains a passage of interest to both mathematicians and physicists, serving to stimulate thought on a problem which has perhaps not been sufficiently understood.

Mr. Hovenden offers a prize of 500 pounds, a goodly sum, to any one who will perform in public the act of multiplying apples and pears by pence, or any similar trick in which our common school algebras abound. He holds this and similar absurdities up to ridicule and we must say we have rarely seen any practical development of science made sport of with a greater semblance of justice. Our algebra works all right in practical life and yet we wonder whether Mr. Hovenden's challenge will not be taken up by some one who believes in algebra.[1]

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[1] We intended to publish a quotation from the original text of Mr. Hovenden's pamphlet, but it has mysteriously disappeared in the ever-yawning

In comment on his severe accusation we wish to say that physical formulas such as the Kepler laws, the laws of gravitation, the laws of motion, etc., employ letters such as *g* for gravity, *t* for time, *d* for distance, etc. But we must bear in mind that these symbols, unlike the letters of algebra, do not stand for the things of which they are abbreviations, but for the number of units of time, distance, etc. The symbol *g* is simply an abbreviation for the number of feet representing the initial velocity of a falling body on earth. In a formula such as $1/2\,gt^2$ we do not multiply time by gravity, which would be nonsense, but we multiply the number of seconds represented by *t* with the number denoting the initial velocity of gravity. This is a big difference, for it would be quite difficult to multiply time by gravity or by mass or any other item which has been abbreviated in the nomenclature of physics by a different letter. The laws of algebra hold good for the formulas of physics, but for all that the physical formulas are quite different from algebra, and have an application of their own.

The science of algebra is an *a priori* construction, and each letter denotes some magnitude of its own which is handled according to the laws of arithmetic, and can be inserted when the conclusion has been made, in which case it will find any magnitude on condition that it remains consistently the same throughout the calculation. It is quite amusing to think that in algebra we are expected to multiply objects such as tables and chairs, or apples and pears, and it would indeed be difficult to comply with the hanky-panky trick in public. Mr. Hovenden's 500 pounds are pretty safe in his pockets if he will pay them only for performing this remarkable feat, but it might have been better for our comprehension of the nature of physics as well as of algebra to offer that same sum for a sensible and clear explanation of the problem which puzzles the vice-president of St. Luke's Lunatic Hospital.

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We sent a copy of these few remarks to Mr. Philip E. B. Jourdain, of Cambridge, England, partly in the hope that he might help us to locate Mr. Hovenden's letter. He makes the following additional comments:

"Hovenden's strictures on the use of symbols in algebra and physics are quite just, and your remarks also seem to me very much to the point. It is very curious that an explanation of Hovenden's

mouth of the editorial waste-paper basket or at the hands of the printer's devil.

difficulty is so rarely given. For this reason, I think the following quotation from De Morgan's *Elements of Algebra* (London, 2d ed., 1837, p. ii) is worth making:

" 'How many of the operations of arithmetic can be performed with concrete numbers, and without speaking of more than one sort of 1? *Only addition and subtraction.* Miles can be added to miles, or taken from miles. Multiplication involves a new sort of 1, 2, 3, etc., standing for *repetitions or times,* as they are called. Take 6 miles 5 times. Here are two kinds of units, 1 mile and 1 time. In multiplication, one of the units must be a number of repetitions or times, and to talk of multiplying 6 feet by 3 *feet,* would be absurd.[2] What notion can be formed of 6 feet taken "3 feet" times?

" 'But in solving the following question, "If 1 yard cost 5 shillings, how much will 12 yards cost?" do we not multiply the twelve *yards* by the five *shillings*? Certainly not—the process we go through is the following: Since each yard costs five shillings, the buyer must put down 5 shillings as often (as many *times*) as the seller uses a one-yard measure; that is, 5 shillings is taken 12 *times.*

" 'In division, we must have the idea either of repetition or of *partition,* that is, of cutting a quantity into a number of equal parts. "Divide 18 miles by 3 *miles,*" means, find out how many *times* 3 miles must be repeated to give 18 miles; but "Divide 18 miles by 3," means, cut 18 miles into three equal parts, and find how many miles are in each part.

" '18 miles divided by 3 *miles* gives 6; meaning, that 3 *miles* must be repeated six *times* to give 18 *miles.*

" '18 *miles* divided by 3 gives 6 *miles*; meaning, that if 18 miles be cut into *three equal parts,* each part is 6 *miles.* The answer in abstract numbers is the same in both cases; 18 divided by 3 gives 6.'

"It might also be mentioned that Mach (*Mechanics,* p. 144) expresses himself accurately about *s/t,* but, as a rule (cf. p. 269), follows the usual procedure of mathematics and uses less accurate expressions simply for the sake of shortness. The difficulty seems to me to arise partly from the neglect of the use of *proportions* instead of *equations* (cf. Mach, p. 157) as I remarked in my little book *The Nature of Mathematics,* pp. 62-64."

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[2] " 'In old books the following is sometimes found. "What is £99. 19s. 11¾d. multiplied by £99. 19s. 11¾d.?" The only intelligible meaning of this is as follows: If a stock of money is to be increased at the rate of £99. 19s. 11¾d. for every £1 in it, how much will that be when the stock itself is £99. 19s. 11¾ d.? Let the student answer this.' "